AROMA: ADVANCED RESOLUTION ORGANIC MOLECULE ANALYZER

Completed Technology Project (2015 - 2018)

Project Introduction

Understanding the origin, distribution and processing of organic compounds in cryogenic planetary environments is one of the most compelling future directions in Solar System research. Such organics are structurally and functionally diverse, despite their low-temperature origins, and are thus thought to constitute an enabling 'prebiotic' inventory for the potential emergence of life. Top-priority planetary science goals for the coming decades will require detailed in situ studies of surface and near-surface composition to elucidate molecular structure and unambiguous identification of complex mixtures of organics derived from icy environments that typify key primitive and planetary bodies. These planned investigations will further our understanding of primordial sources of organic matter, and the role and distribution of ancient Solar System and interstellar materials with implications for the delivery of water, volatiles and hydrocarbons to Earth and other planetary bodies. Comets, Jupiter's Europa, and Saturn's moons, Titan and Enceladus, represent examples of such organic-rich targets that will be centerpieces to scientific exploration in the next decade. We propose to develop a highly capable mass spectrometer instrument suite that will transform our understanding of these and other planetary environments. This comprehensive, in situ investigation requires versatile and high-performance instrumentation capable of: 1. Quantitative measurements of trace levels (e.g., ppmw) of organic and inorganic compounds over a wide range of volatility, ionization potential and molecular weight; 2. Selective excitation and isolation of targeted mass ranges for enhanced signal-to-noise (and by extension limits-of-detection) and controlled ion manipulation and ejection; 3. Induced fragmentation of parent molecules and structural analysis of daughter ions via multiple stages of mass spectrometry (i.e., MSn operations) for the unambiguous identification of complex organic compounds and differentiation of isomers; and, 4. Mass discrimination and disambiguation of isotopologues and organic and inorganic isobaric interferences with high-resolution (i.e., m/μm 10,000) and mass accuracy. The proposed Advanced Resolution Organic Molecule Analyzer (AROMA) instrument will meet all of these performance requirements.

Anticipated Benefits

The AROMA investigation represents a major leap forward in the advancement of highly capable mass analyzers that serve as our best means to detect trace levels of organic materials and ultimately identify chemical signatures indicative of extraterrestrial life. The wide-ranging capabilities and unprecedented miniaturization of this instrument could benefit a litany of future NASA and/or international mission concepts, as well as commercial (e.g., oil prospecting), medical (e.g., tissue analysis), and defense applications (e.g., forensic science).

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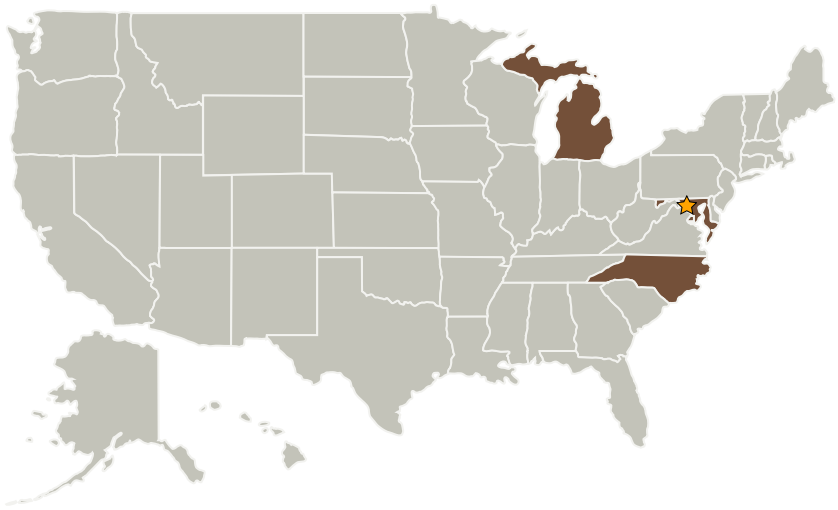
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★Goddard Space Flight Center(GSFC)	Lead Organization	NASA Center	Greenbelt, Maryland

Primary U.S. Work Locations	
District of Columbia	Maryland
Michigan	North Carolina

Organizational Responsibility

Responsible Mission Directorate:

Science Mission Directorate (SMD)

Lead Center / Facility:

Goddard Space Flight Center (GSFC)

Responsible Program:

Planetary Instrument Concepts for the Advancement of Solar System Observations

Project Management

Program Director:

Carolyn R Mercer

Program Manager:

Haris Riris

Principal Investigator:

Ricardo D Arevalo

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Completed Technology Project (2015 - 2018)

Project Management *(cont.)*

Co-Investigators:

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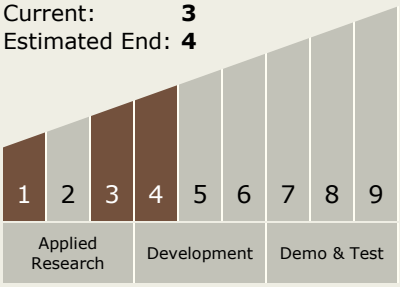
Technology Maturity (TRL)

Start: **1**
Current: **3**
Estimated End: **4**



Technology Areas

Primary:

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AROMA: ADVANCED RESOLUTION ORGANIC MOLECULE ANALYZER

Completed Technology Project (2015 - 2018)

Technology Areas *(cont.)*

- TX08 Sensors and Instruments
  - TX08.3 In-Situ Instruments and Sensors
    - TX08.3.4 Environment Sensors

Target Destination

Others Inside the Solar System